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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. EL 908622028 US Richard Harty 2/19/2004

Print Name: Richard Harty

17858 U.S. PTO
60/545829

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TITLE OF THE INVENTION (500 characters max)

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ENCLOSED APPLICATION PARTS ***(check all that apply)***

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☑ Other (specify) Return Postcard

☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fees.

☑ The Director is herby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 23-0503

☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE Amount ($): 160.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are:

Respectfully submitted,

SIGNATURE

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Date February 19, 2004

REGISTRATION NO. 29,809
(if appropriate)
Docket Number: 04-355-6-7 (16948)

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

PROVISIONAL APPLICATION COVER SHEET
Additional Page

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Docket Number	04-355-6-7 (16948)

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Waters

Docket No. 04-355-6-7
(16948)

CERTIFICATE OF MAILING BY "EXPRESS MAIL"
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TITLE OF INVENTION:
PIN VALVE ASSEMBLY

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ASSIGNEE: WATERS INVESTMENTS LIMITED

APPLICATION NUMBER (if known): UNKNOWN

MAIL STOP- PROVISIONAL APPLICATION
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I hereby certify that the correspondence identified in the transmittal below is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR § 1.10 in an envelope addressed to: Mailstop Provisional Applications, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on February 19, 2004

Richard Harty

Richard Harty

TRANSMITTAL LETTER

Enclosed for filing in the above identified patent case are the following documents:

Provisional patent application transmittal letter (2 pg.); Specifications including claims and abstract (25 pgs), Drawings (9 pgs), and Prepaid return postcard

February 19, 2004
Reg. No. 29,809

Anthony J. Janiuk

Docket No. 04-355-6-7
(16948)

PIN VALVE ASSEMBLY

TECHNICAL FIELD

The present invention relates generally to high pressure liquid chromatography ("HPLC"), and more particularly to a valve assembly for high pressure fluids that uses pins to block flow pathways in a fluid network.

BACKGROUND

The practice of HPLC generally requires that a molecular species to be separated or analyzed be dissolved in a liquid, the mobile phase, and conveyed by that liquid through a stationary phase. In the stationary phase, a large surface area is presented which is in intimate contact with the mobile phase. Mixtures of analyte compounds, dissolved in the mobile phase, can be separated during passage through the column by processes of adsorption or retention, which act differently on the various analyte species. The differential retention causes the analytes to elute from the column with respect to time and volume. The eluting analytes will typically transit through an in-line detector, where quantitative and/or qualitative examination of analytes will occur.

High pressure liquid chromatography solvent delivery systems are used to source either single-component liquids or mixtures of liquids at selected pressures which can range from substantially atmospheric pressure to pressures on the order of ten thousand pounds per square inch and more. The above pressures are required to force the mobile phase through the fluid passageways of a stationary phase support, where separation of dissolved analytes can occur. The stationary phase support may comprise a packed bed of

particles, a membrane or collection of membranes, a microfabricated structure typically comprising an array of fluid passageways etched into a solid support, or an open column or tube.

The separation process occurring in liquid chromatography can result in the separation of an injected sample mixture into its component parts. These component parts are eluted from the column in reasonably distinct zones or bands. As these bands pass through a detector, their presence can be monitored and a detector output can be produced. This output includes a pattern of analyte concentration within the eluting bands, which can be represented by means of a time varying electric signal, and gives rise to the nomenclature of a "chromatography peak."

The utility of chromatography relies heavily on run-to-run reproducibility, such that a given analysis can be compared with an analysis of standards or calibrates with confidence in the resulting data. Known pumping systems exhibit some non-ideal characteristics which result in diminished separation performance and diminished run-to-run reproducibility.

Among the non-ideal pump characteristics exhibited in known pumping systems are, generally, fluctuations in solvent composition and/or fluctuations in volumetric flow rate. Such volumetric flow rate fluctuations in present and known HPLC pumping systems disadvantageously cause varying retention times for a given analyte. That is, the amount of time that an analyte is retained in the stationary phase fluctuates undesirably as a function of the undesirable volumetric flow rate fluctuations. This creates difficulties in inferring the identity of a sample from the retention behavior of the components.

Volumetric flow rate fluctuations can result in fluctuations in solvent composition when the output of multiple pumps is summed to provide a solvent composition.

Fluctuations in solvent composition in present and known HPLC systems disadvantageously result in interactions with the systems analyte detector and produce perturbations that are detected as if they arose from the presence of a sample. In effect, an interfering signal is generated. This interfering signal is summed with the actual signal attributable to the analyte, producing errors when the quantity of an unknown sample is calculated from the area of the eluting sample peak.

The typical valve assemblies used in these high pressure fluid systems require tight tolerances and uniform performance hundreds of times under extreme working conditions. This wear results in the high wear of parts and whole assemblies leading to degradation of results.

In light of the above, the requirements imposed on HPLC solvent delivery systems are severe. New HPLC pumps and valves are typically required to deliver solvents at pressures that can range from several pounds per square inch to as much as 100,000 psig. There are problems and non-ideal effects associated with delivering liquids for chromatography against elevated pressures including seal deformation under load and absolute seal leakage. HPLC pumps are expected to output the mobile phase solvent at precisely controlled flow rates in a smooth and uniform manner. In the case of gradient chromatography, where a fixed solvent composition is blended in real time during the separation, there is the further requirement that mobile phase composition as well as flow rate be precisely and accurately controlled during delivery. However, system operating pressures may be changing very substantially during the separation and the

compressibility of the constituent mobile phase solvents may be quite different. Additionally, continuous-delivery pumping systems create tremendous wear on the pumping and valve systems.

The large problems associated with the control of high pressure fluids with high precision and minimal fluid disturbance can be minimized by the use of robust, valve assemblies.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially exploded view of one embodiment of the present invention.

FIG. 2 is a cross sectional view of one embodiment of the present invention.

FIG. 3 is a perspective view of one embodiment of the present invention.

FIG. 4 is a detailed cross sectional view of a fitting port, channel and pin valve seat of one embodiment of the present invention.

FIG. 5 is a schematic representation of one embodiment of the present invention.

FIG. 6 is a plan view of one embodiment of the present invention.

FIG. 7 is an exploded view of one embodiment of a pin valve of the present invention.

FIG. 8 is a detailed exploded view of another embodiment of a pin valve of the present invention.

FIG. 9 is a plan view of one embodiment of a fluid plate of the present invention.

FIG. 10 is a detailed cross sectional view of a pin valve and fluid channel.

SUMMARY OF THE INVENTION

The invention involves a pin valve assembly comprising a pin block housing pin valves, a fluid plate with a fluid channel for fluidically communicating with the pin valves, and a fitting block housing fittings for fluidic communication with the fluid plate and for fluidic communication with fluidic components. The assembly has one or more fitting ports, aligned with the fittings, and one or more pin valve seats, aligned with the pin valves. The fitting ports can be integrated into the fluid channel of the fluid plate or integrated into the fittings of the fitting block. Similarly, the pin valve seats can be integrated into the fluid channel of the fluid plate or integrated into the pin valves themselves.

The pin block is preferably a substantially cylindrical stainless steel block with six bores longitudinally through. The bores may be parallel or at an angle to each other. Whatever the angle in relation to each other, the bores must place the distal pin end of a pin valve into alignment with the fluid plate thereby placing a pin valve seat in intersection with the fluid channel. If the pin valve seat is integrated into the pin valve, the placement of the pin valve must provide for the seat to intersect the channel. If the pin valve seat is integrated into the fluid channel of the fluid plate, the pin valve must sit within the pin valve seat when extended.

The six bores of the pin block provide for six pin valves to be placed in proximity to and communication with the fluid plate. The fluid plate is preferably a stainless steel, substantially cylindrical plate being much shorter than the pin block in the longitudinal or height direction. The fluid plate can be coated with a polymer. Alternatively, the fluid

plate can have a substantially flat polymer shim on its proximal and/or distal surfaces. The polymer can be, but is not limited to, fluorocarbon or more preferably tetrafluoroethylene.

The plate is also preferably smaller in diameter than the pin block and formed to partially fit within a depression on the distal end of the pin block. The fluid plate can have a fluid channel that provides for a fluid sample to flow under pressure throughout its extent. Alternatively, the fluid plate can have one or more separate channels with channel ends.

In one embodiment, pin valve seats intersect the fluid channel on its proximal side such that, when a pin valve is sitting in its seat, the fluid is substantially prevented from flowing beyond that particular pin valve, hence the valve is closed. The distal side of the fluid plate is intersected with fitting ports that communicate to fluidic fittings and to the channels of the fluid plate. However, in another embodiment, the pin valve seats and fitting ports can be on the same side of the fluid plate.

The fitting block houses fluidic fittings in positions that provide fluidic communication with the fluid plate. The fittings are commonly for a sample syringe, a pump syringe, a pump, a chromatographic column and both ends of a sample loop. It is preferable that the proximal end of the fitting block be substantially cylindrical and have a depression to partially fit the fluid plate. It is also preferable that the fitting block be fitted to the pin block while holding the fluid plate in place there between. Screws, complimentary threading or other known means may hold the pin block and fitting block together.

In typical operation of the present invention, pin valves are actuated to sit on or lift from the pin valve seats blocking or allowing a fluid sample to flow through the channels of the fluid plate. Each pin valve can be housed in a standardized housing comprising a means for actuation for axially moving the pin valve to sit on the pin valve seat and substantially block fluid flow from a down stream location or remove the pin from the pin valve seat and provide for fluid flow to the down stream location. Alternatively, the pin valve seat can be integrated into the pin valve and move and perform similarly. Actuation of the pin valve places the pin valve and pin valve seat on the fluid channel of the fluid plate, to substantially block the flow of fluid through the channel.

When used as an injection valve for an HPLC system, the invention has a load position where the sample is introduced through a sample syringe in communication with a fitting port on the fluid plate. Two pin valves close the fluid channel between the pump and the column and a third closes the channel between the pump syringe and the sample syringe. Therefore, the pump syringe is able to generate negative pressure in the fluid channel across the sample loop to the sample allowing for the sample to be drawn into the sample loop. In the inject position, two pin valves are actuated to close the channels between the sample syringe and the pump syringe and a third pin valve closes the channel between the pump and column. This inject position allows the pump to inject the sample contained in the sample loop into a column in communication with fluid plate by a fitting port by pressure exerted from a pump also in communication with a fitting port.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows an exploded view of the pin valve assembly 50 of the present invention. The pin valve assembly 50 comprises a pin block 60, which is shown with the pin valves 62 inserted into the block 60 at its proximal end. Preferably, the pin block 60 is substantially cylindrical as shown. As best seen in FIG. 2, the pin block 60 comprises one or more bores 200 or passages provided for housing the pin valves 62. FIG.3 shows the preferred embodiment where the entrance to each bore is aligned along the circumference of the pin block 60, although this is not critical to the invention. The bores 200 extend longitudinally through the pin block 60 allowing the distal ends of the pin valves 62 to impinge on the fluid plate 64, which preferably has a smaller circumference than the bore entrances and the pin block 60 generally. The pin valves 62 can be placed in a housing that conforms to the bores such that the pin valve housing is held substantially in place. In a modular embodiment, the pin valve housing and bore are releasably fitted such that a pin valve in its housing may be easily removed and replaced with another pin valve.

The pin block 60 has a recessed portion 66 at its distal end that conforms to the shape and size of the fluid plate 64. The pin block 60 also has a complimentary means for attaching to the fitting block 68. Preferably, the pin block 60 and fluid block 68 are screwed together and in the embodiment of FIG. 1, there are three screw holes one of which is in view 70 in FIG 2. Additionally, an alignment pin 71and holes 72, 73 are utilized to align the fluid plate 64, pin block 60 and fitting block 68.

The fluid plate 64 is a substantially planar plate on which is disposed a fluid channel 510 (partially shown in FIG. 4 and shown schematically in FIGS. 5 & 9). The

fluid channel can be a single circumferential channel or a plurality of channels. The channel 510 is intersected with pin valve seats 500 adapted to provide a seat for the pin valves 62 to block the fluid flowing through the channel 510. These channels 510 can be disposed to provide an interconnected track intersected by fluidic fitting ports 502 that communicate to external fluidic components such as pumps and chromatographic separation columns. Preferably, the proximal side of the fluid plate 64 has pin valve seats 500 while the distal side has the fluidic fitting ports 502.

Alternatively, the fluid plate can have one or more separate channels. These channels are also intersected by fluidic fitting ports and pin valve seats. In this embodiment the structure of the pin valve seat provides for fluidic communication between the separate channels. As discussed further, FIG. 10 demonstrates one embodiment of the pin valve seat having passages that communicate with separate channels.

The fitting block 68 comprises fitting bores 74 that house and align fluidic fittings 210 with the fluid plate 64. The fitting bores 74 are provided to conform to the fluidic fittings 210 and hold the fittings substantially in place such that the fittings can fluidically communicate with the fluid plate 64. The fluidic fittings 210 preferably communicate with fluidic components (not shown) such as a sample syringe, and pump syringe, both sides of a sample loop, a pump and a packed column. The sample loop can alternatively be incorporated directly into the fluid plate 64, as are the channels 510.

The pin block and fitting block are preferably stainless steel. The fluid plate is preferably stainless steel coated with a fluorocarbon polymer such as Teflon or faced with a fluorocarbon polymer shim. However, any material that can withstand the use

over a reasonable period of time may be used. Other possibilities include titanium, ceramics, poly ether ether ketone (PEEK), polyphenylene sulfide (PPS), and other thermoplastics.

FIG. 2 is a cross-sectional view of the assembled pin block 60, fluid plate 64, and fitting block 68. The fluidic fittings 210 are shown in communication with the fluid plate 64 through a fluidic fitting port 211. One embodiment of this is shown in detail in FIG. 4. The pin housing 200 in cross section shows the pin valve from distal to proximal end comprising seals 212, a seal load sleeve 214, a Belleville spring 216, a nut seal 218, a second Belleville spring 220, and a nut 222.

FIG 5 is a schematic representation of the fluid plate, fluid channel 510, fitting ports 211, fluidic components, pin valves (1-6) and pin valve seats 500 for a chromatographic application. The pin valves each sit in a pin valve seat 500 to block the flow of fluid through the channel 510 of the fluidic plate 64. When in a load stage, pin valves 3, 5, and 1 are open, while pin valves 4, 2, and 6 are closed. This allows the sample to be loaded into the sample loop and prevents the sample from entering the channels that lead to the column or pump. In an inject stage, pin valves 6, 2, and 4 are open while pin valves 1, 3, and 5 are closed. This allows the sample to be injected into the column and processed.

The pin valves may be designed as a cartridge to modularize the pin valve assembly. The cartridges 600 as shown in FIG. 6 comprise a standardized housing 602 preferably of molded polyphenylene sulphide but the material may be of any known material that can properly withstand the stresses to which the invention is typically exposed. At the proximal end of the cartridge is a pin lift assembly 610 used to actuate

the pin 604 to either its extended position or its unextended position. The extended position prevents fluid flow to a down stream location by extending the pin 604 from the housing 602 to sit in a pin valve seat. The unextended position has the pin 604 retracted back from the pin valve seat and preferably into the housing 602 for providing fluid flow to a down stream position. The pin pressure, seal pressure and pin lift can be controlled by a spring housed in the housing 602 or by known methods. Rotation of the lift assembly by known means provides for the spring to compress or decompress to equilibrium providing the required force to displace the pin 604 to its extended or unextended positions. Preferably, the pin 604 can be actuated, or the actuation may be assisted, pneumatically by pressurized gas using known methods.

The cartridge 600 is adapted to fit into the bores of the pin valve assembly. A key or other known means may be used to orient the cartridge 600 in the pin block. This modular design can provide for pin pressure to be adjusted by replacing a pin and housing with another pin and housing of different spring tension. Additionally, worn valves may be easily replaced using this embodiment. The modular cartridge housing 600 is complimented by the bores of the pin block 60 to be releasably fitted by known means.

FIG. 7 provides a detailed exploded view of an embodiment of a single pin valve of the present invention. At the distal end of this embodiment is a ring seal of polytetrafluoroethylene (PTFE) surrounded by two PEEK ring seals 710. A seal load sleeve 712 houses the ring seals at its distal end and has a wider circumference at its proximal end upon which sits Belleville spring 714. A load ring 718 integral to a pin 720 holds a nut seal 716 on the Belleville spring 714. The pin has a smaller circumference

portion 717 at its distal end. The pin 720, up to its load ring 718, passes through the nut seal 716, Belleville spring 714, seal load sleeve 712. The smaller circumference portion 717 of the pin 720 passes through the ring seals 710 with its most distal portion capable of impacting the fluid plate at a pin valve seat 500. On the proximal side of the load ring 718 is a second Belleville spring 722, and a nut 724 to apply axial compression force. The distal end of the pin 717 can have a diamond-like carbon coating.

FIG. 8 is a detailed exploded view of an embodiment of a pin valve in a modular, cartridge configuration. A pin 800 passes through ring seals 810 and a load sleeve 812 within the cartridge housing 602. In this embodiment, the valve seat 802 is fitted to the pin valve rather than being fitted on the fluid plate.

A further embodiment of the fluid plate is shown in FIG 9. With the pin valve seat fitted to the pin valve the fluid plate 904 can comprise six separate channels 900. The pin valve seat can be placed in an overlapping position over two channel ends 910. The pin valve seat 912 as shown in detail in FIG. 10 comprises two passages914, 916 at angles provided to reach the separate channel ends 910. When withdrawn, the pin allows the passages 914 and 916 to communicate. When extended, the pin substantially blocks at least one passage.

Accordingly, it should be readily appreciated that the device and method of the present invention has many practical applications. Additionally, although the preferred embodiments have been illustrated and described, it will be obvious to those skilled in the art that various modifications can be made without departing from the spirit and scope of this invention. Such modifications are to be considered as included in the following claims.

IN THE CLAIMS

1. A pin valve assembly comprising:

a pin block housing a pin valve;

a fluid plate with a fluid channel for fluidically communicating with the pin valve; and

a fitting block housing a fitting for fluidic communication with the fluid plate and for fluidic communication with fluidic components.

2. A pin valve assembly as in claim 1 further comprising:

a fitting port, aligned with the fitting, and a pin valve seat, aligned with the pin valve.

3. A pin valve assembly as in claim 2 wherein:

the fitting port is integrated into the fluid channel of the fluid plate.

4. A pin valve assembly as in claim 2 wherein:

the pin valve seat is integrated into the fluid channel of the fluid plate.

5. A pin valve assembly as in claim 2 wherein:

the fitting port is integrated into the fitting.

6. A pin valve assembly as in claim 2 wherein:

the pin valve seat is integrated into the pin valve.

7. A pin valve assembly as in claim 1 wherein:

the fitting block is coupled to the pin block with the fluid plate positioned between the pin block and fitting block.

8. A pin valve assembly as in claim 7 wherein:

the fitting block is coupled to the pin block by a screw connection.

9. A pin valve assembly as in claim 1 wherein:

the pin valve comprises a pin with distal and proximal ends substantially axially disposed in a housing.

10. A pin valve assembly as in claim 9 wherein

the distal end of the pin has a diamond-like carbon coating.

11. A pin valve assembly as in claim 1 wherein:

the pin valves are actuated by an actuator to provide for a distal end of the pin valve to sit in a pin valve seat substantially sealing the fluid channel and removing the distal end of the pin valve from the pin valve seat opening the fluid channel.

12. A pin valve assembly as in claim 1 wherein:

the pin block houses six pin valves substantially equidistant from each other around the outside circumference of the pin block aligned with six pin valve seats on the fluid plate.

13. A pin valve assembly as in claim 1 wherein:

the pin valve comprises a ring seal above the distal end of the pin and within a pin housing for providing sealing of the fluid plate.

14. A pin valve assembly as in claim 1 wherein:

the fluidic components are an HPLC system pump syringe, pump, column, sample loop and sample syringe.

15. A pin valve assembly as in claim 1 wherein:

each pin valve is housed in a housing comprising an actuator for axially moving the pin valve to sit on the pin valve seat and substantially block fluid flow from a downstream location or remove the pin from the pin valve seat and provide for fluid flow to the down stream location.

16. A pin valve assembly as in claim 1 wherein:

the pin valve comprises pin seals, a seal load sleeve, a Belleville spring, and a nut seal around a distal end of a pin below a load ring, and a second Belleville spring and a nut above the load ring.

17. A pin valve assembly as in claim 16 wherein:

the pin seals are two polyetheretherketone washers surrounding a polytetrafluoroethylene washer.

18. A pin valve assembly comprising:

a pin block for housing pin valves;

a fluid plate with a fluid channel for fluidically communicating with the pin valves; and

a fitting block for housing fittings for fluidic communication with the fluid plate and fof fluidic communication with fluidic components.

19. A pin valve assembly as in claim 18 further comprising:

pin valves housed within the pin block; and

fittings housed within the fitting block.

20. A pin valve assembly as in claim 19 further comprising:

one or more fitting ports, aligned with the fittings, and one or more pin valve seats, aligned with the pin valves.

21. A pin valve assembly as in claim 20 wherein:

the fitting ports are integrated into the fluid channel of the fluid plate.

22. A pin valve assembly as in claim 20 wherein:

the pin valve seats are integrated into the fluid channel of the fluid plate.

23. A pin valve assembly as in claim 20 wherein:

the fitting ports are integrated into the fittings.

24. A pin valve assembly as in claim 20 wherein:

the pin valve seats are integrated into the pin valves.

25. A pin valve assembly as in claim 18 wherein:

pin valves impinge on the pin valve seat with which it aligns and substantially block the flow of fluid through the fluid channel of the fluid plate.

26. A pin valve assembly as in claim 25 wherein:

each pin valve is housed in a standardized housing comprising a means for actuation for axially moving the pin valve to sit on the pin valve seat and substantially block fluid flow from a downstream location or remove the pin from the pin valve seat and provide for fluid flow to the down stream location.

27. A pin valve assembly as in claim 26 wherein:

the pin valve housing is releasably fitted to the pin block.

28. A pin valve assembly as in claim 18 wherein:

the fluid plate is stainless steel coated with a fluorocarbon polymer.

29. A pin valve assembly as in claim 28 wherein:

the fluorocarbon polymer is tetrafluoroethylene.

30. A pin valve assembly as in claim 18 wherein:

the fluid plate is stainless steel with a substantially flat fluorocarbon polymer shim on its surface that is impinged by the pin valve.

31. A pin valve assembly as in claim 30 wherein:

the fluorocarbon polymer is tetrafluoroethylene.

32. A pin valve assembly as in claim 18 wherein:

the fitting block is coupled to the pin block with the fluid plate positioned between the pin block and fitting block.

33. A pin valve assembly as in claim 18 wherein:

the pin valve comprises a pin with distal and proximal ends substantially axially disposed in a housing.

34. A pin valve assembly as in claim 33 wherein:

the pin valves are actuated by an actuator to provide for the distal end of the pin valve to sit in the pin valve seat substantially sealing the fluid channel and removing the distal end of the pin valve from the pin valve seat opening the fluid channel.

35. A pin valve assembly as in claim 34 wherein:

the actuator is pneumatically operated.

36. A pin valve assembly as in claim 18 wherein:

the fluidic components are an HPLC system pump syringe, pump, column, sample loop and sample syringe.

37. A pin valve assembly as in claim 18 wherein:

each pin valve is housed in a standardized housing comprising a means for actuation for axially moving the pin valve to sit on the pin valve seat and substantially block fluid flow from a downstream location or remove the pin from the pin valve seat and provide for fluid flow to the down stream location.

38. A pin valve assembly comprising:

a pin block housing pin valves with pin valve seats;

a fluid plate with one or more channels having channel ends; and

a fitting block housing fittings for fluidic communication with fitting ports in fluidic communication with the pin valve seats and for fluidic communication with fluidic components.

39. A pin valve assembly as in claim 38 wherein:

the fitting ports are integrated into the fluid plate.

40. A pin valve assembly as in claim 38 wherein:

the fitting ports are integrated into the fittings.

41. A pin valve assembly as in claim 38 wherein:

the pin valves are aligned with the channels of the fluid plate.

42. A pin valve assembly as in claim 38 wherein:

the channels of the fluid plate comprise six channels with ends.

43. A pin valve assembly as in claim 38 wherein:

the pin valves each align with two channel ends of the fluid plate.

44. A pin valve assembly as in claim 42 wherein:

the pin valve seats comprise a first passage for fluidic communication with a channel end and a second passage for fluidic communication with another channel end.

45. A pin valve assembly as in claim 38 wherein:

the pin valves comprise a pin for substantially blocking fluidic communication between the first and second passage of the pin valve seat.

46. A pin valve assembly as in claim 44 wherein:

the pin is actuated to block the first and second passage of the pin valve seat by an actuator.

47. A pin valve assembly as in claim 45 wherein:

the actuator is actuated pneumatically.

48. A pin valve assembly as in claim 46 wherein:

the pin valve comprises a pin for substantially blocking fluidic communication between the pin valve seat and the fluid plate.

49. A pin valve assembly as in claim 38 wherein:

each pin valve is housed in a standardized housing releasably fitted to the pin block.

50. A pin valve assembly as in claim 38 wherein:

the fluid plate is stainless steel coated with a fluorocarbon polymer.

51. A pin valve assembly as in claim 38 wherein:

the fluorocarbon polymer is tetrafluoroethylene.

52. A pin valve assembly as in claim 50 wherein:

the fluid plate is stainless steel with a substantially flat fluorocarbon polymer shim on its surface that is impinged by the pin valve.

53. A pin valve assembly as in claim 38 wherein:

the fluorocarbon polymer is tetrafluoroethylene.

54. A pin valve assembly as in claim 52 wherein:

the fitting block is coupled to the pin block with the fluid plate positioned between the pin block and fitting block.

55. A pin valve assembly as in claim 38 wherein:

the pin valves are actuated by an actuator to provide for a distal end of the pin valve to sit in the pin valve seat and removing the distal end of the pin valve from the pin valve seat.

56. A pin valve assembly as in claim 55 wherein:

the actuator is pneumatically operated.

57. A pin valve assembly as in claim 38 wherein:

the fluidic components are an HPLC system pump syringe, pump, column, sample loop and sample syringe.

58. A method of controlling the flow of a fluid comprising:

providing a fluid plate with a connected fluid channel, intersecting pin valve seats, and fluidic fitting ports;

supplying fluid to the fluid channel from a fluidic component in communication with the fluidic fitting ports;

moving the fluid by use of the fluidic components; and

sealing the fluid channel at selected pin valve seats by impinging on the seats with corresponding pin valves.

59. A method of controlling the flow of a fluid as in claim 58 wherein:

the fluidic components are an HPLC system pump syringe, pump, column, sample loop and sample syringe.

60. A method of controlling the flow of a fluid as in claim 59 wherein:

during a load stage the fluid channel is open for fluidic communication from the sample syringe through the sample loop and from the sample loop through the system syringe and sealed from fluidic communication from the sample loop to the pump, from the sample loop to the column and from the sample syringe to the pump syringe; and,

during an inject stage the fluid channel is open for fluidic communication from the pump through the sample loop and from the sample loop through the column and sealed from fluidic communication from the pump through the column and from the sample syringe through the sample loop and from the sample loop through the pump syringe.

61. A method of controlling the flow of a fluid as in claim 59 wherein:

during a load stage the pin valves provide for a fluid sample to be transferred from the sample syringe and loaded into the sample loop by a pressure difference created by the pump syringe and during an inject stage the pin valves provide for the sample to be injected from the sample loop into the column by a pressure difference created by the pump.

ABSTRACT

A pin valve assembly and a method of controlling the flow of fluids comprising a pin block housing pin valves, a fluid plate with a fluid channel for fluidically communicating with the pin valves, and a fitting block housing fittings for fluidic communication with the fluid plate and for fluidic communication with fluidic components. The fluid flow through the channels of the fluid plate are controlled by the fluidic components and the pin valves.

Fig. 1

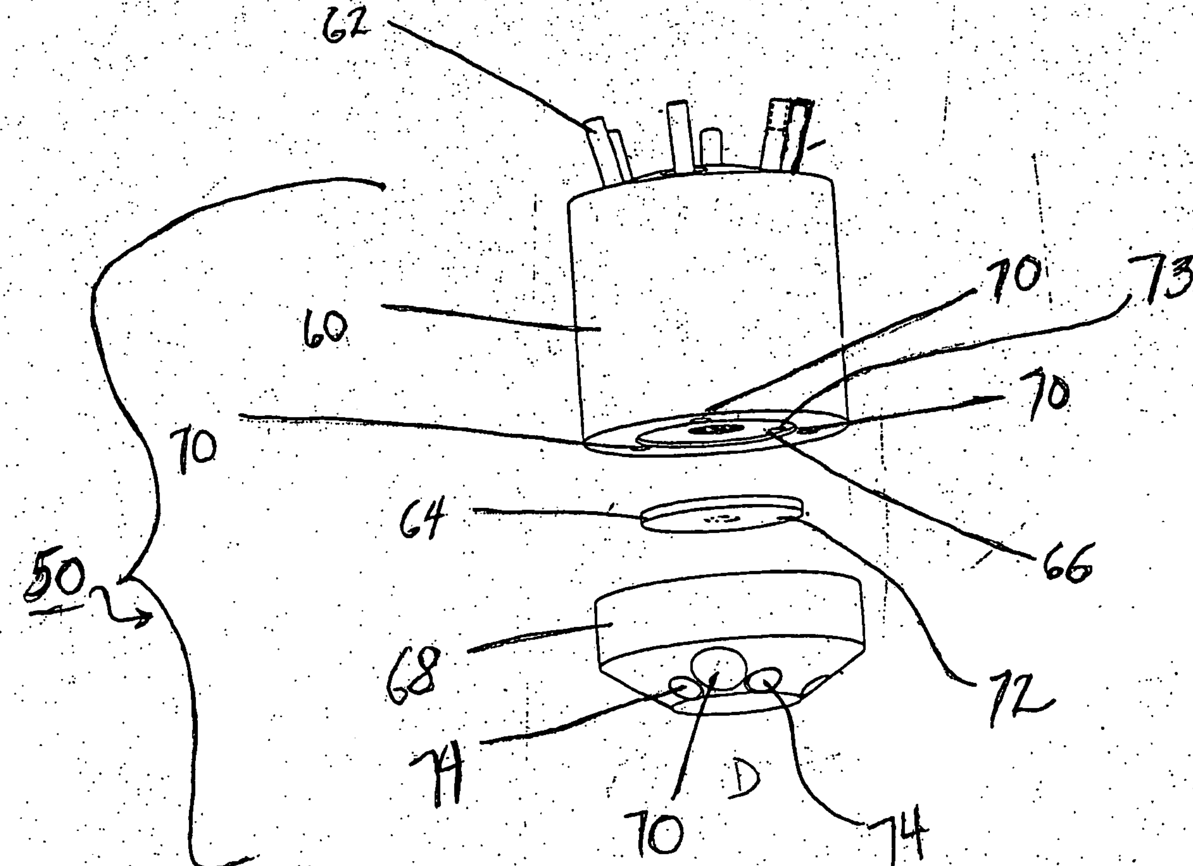


FIG 2

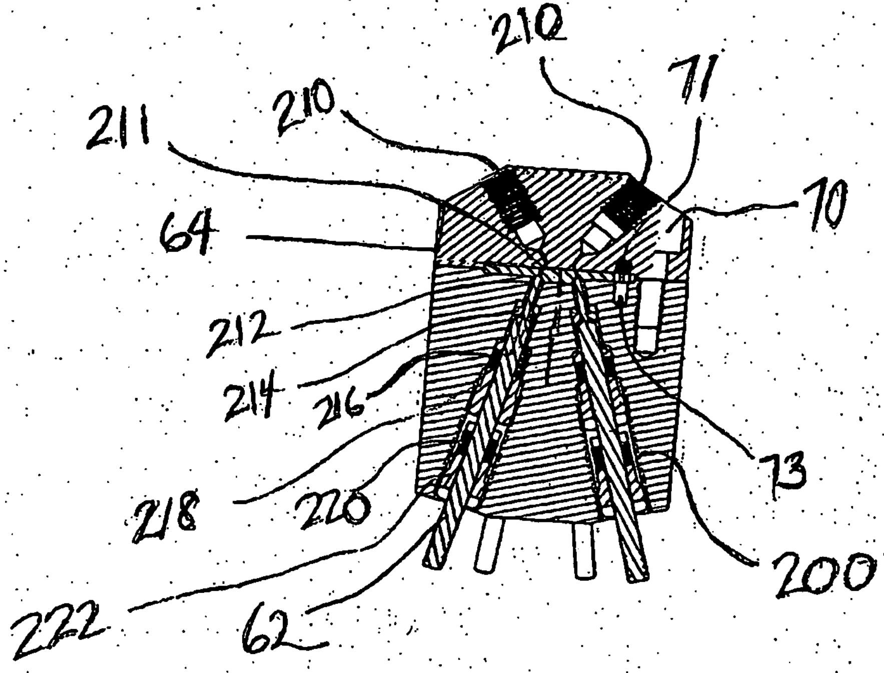
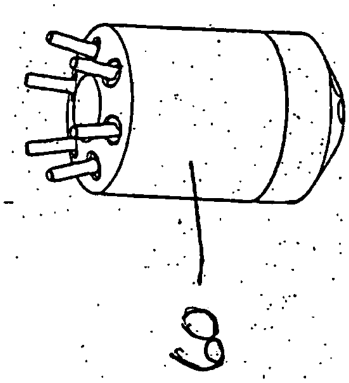


FIG.3



Docket No. 04-355-6-7
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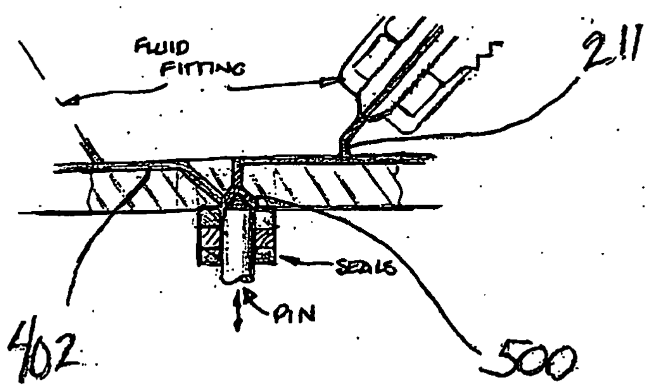
FIG. 4



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(16948)

FIG 5

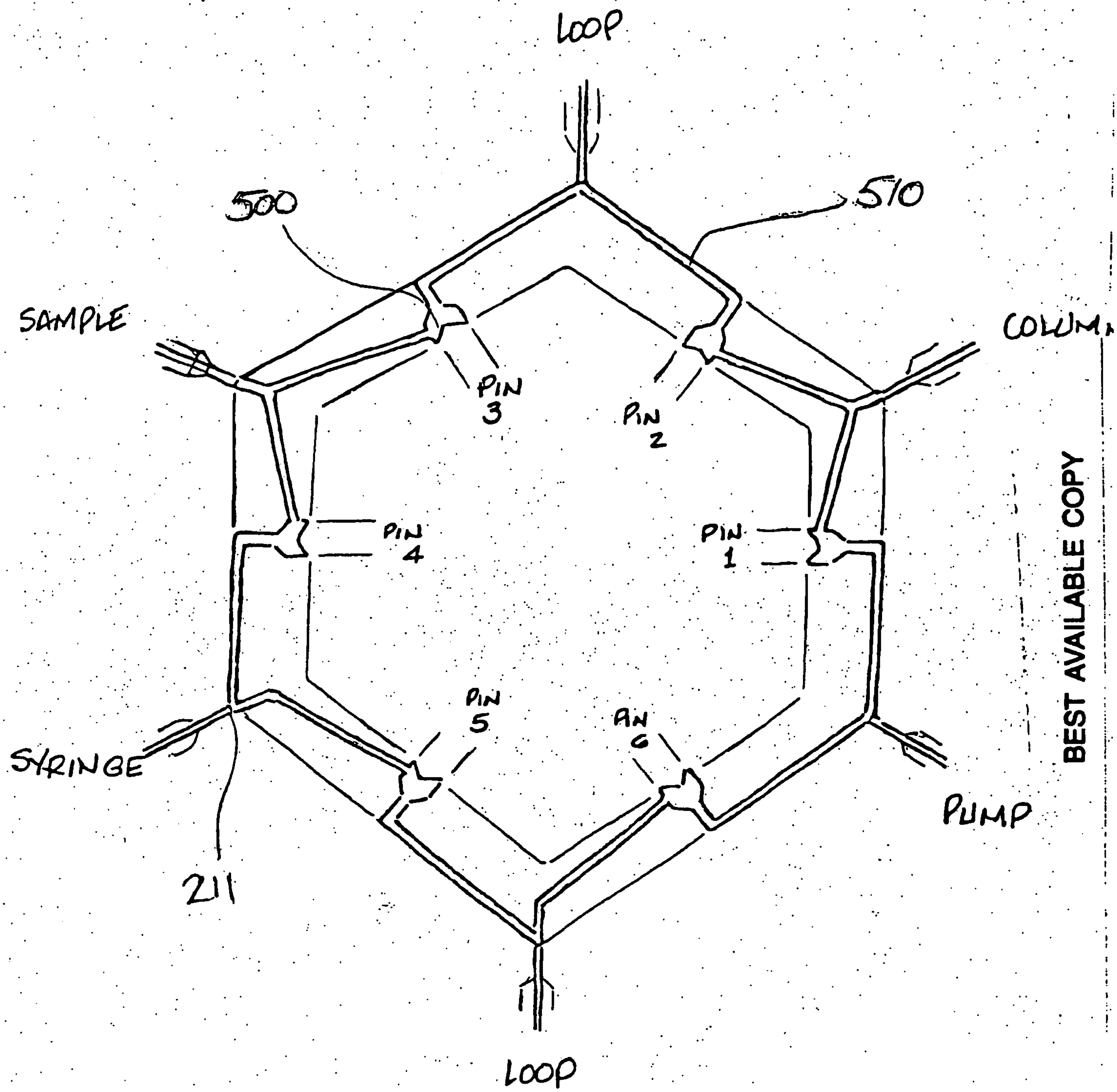

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FIG C.

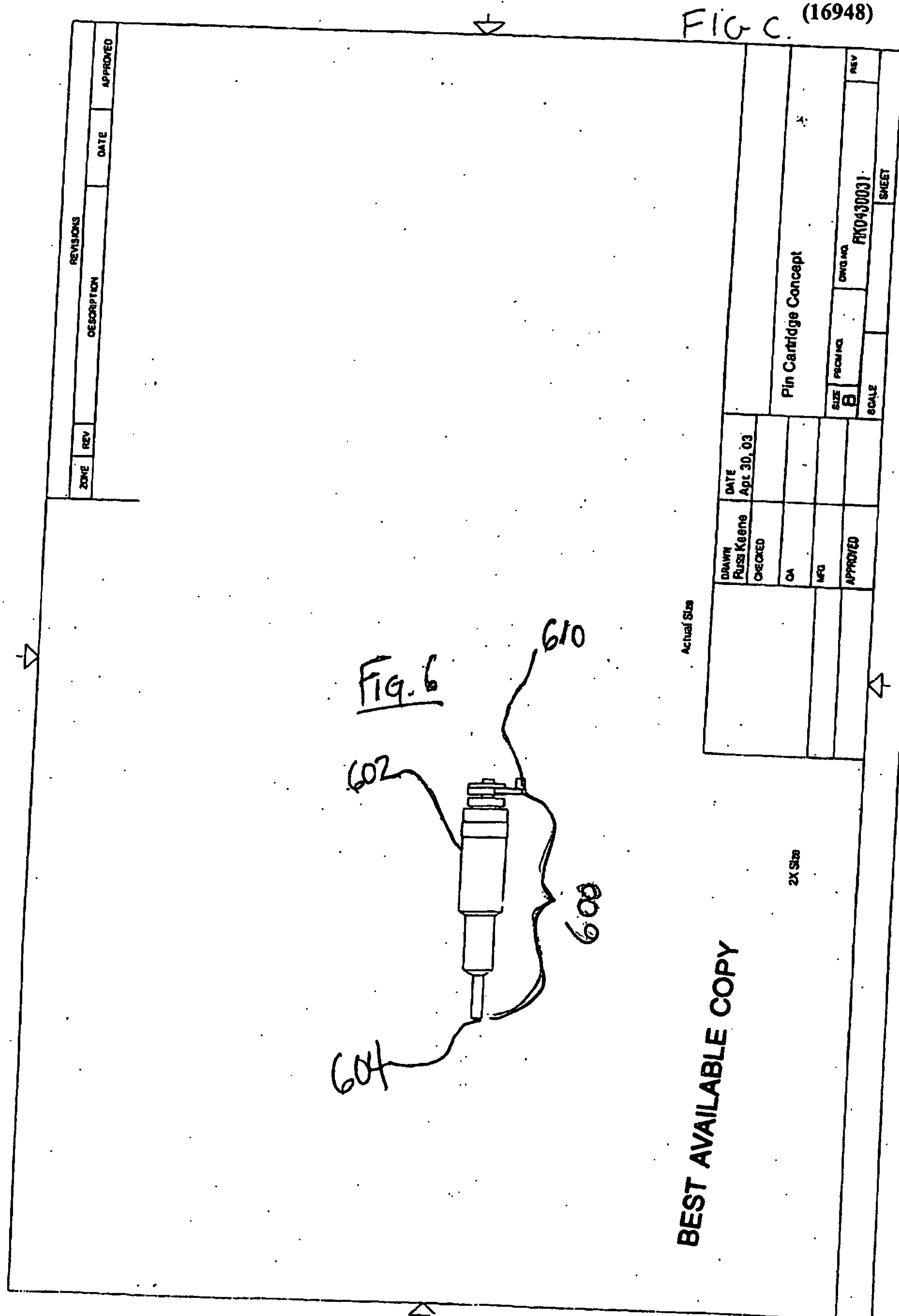
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Fig. 6

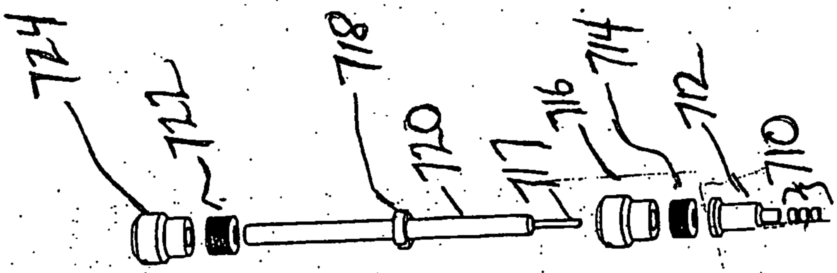


FIG. 7

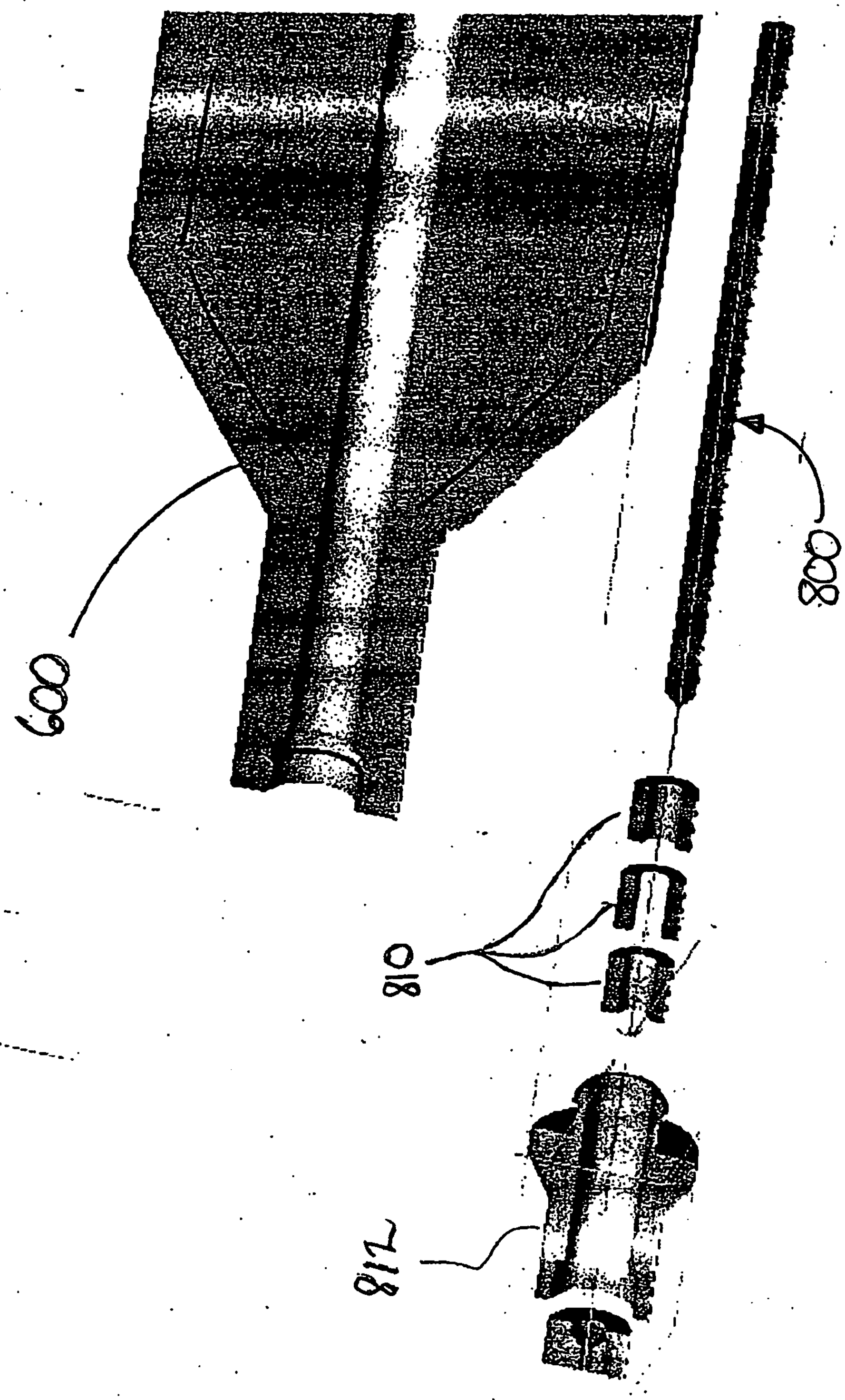


FIG 8

FIG. 9

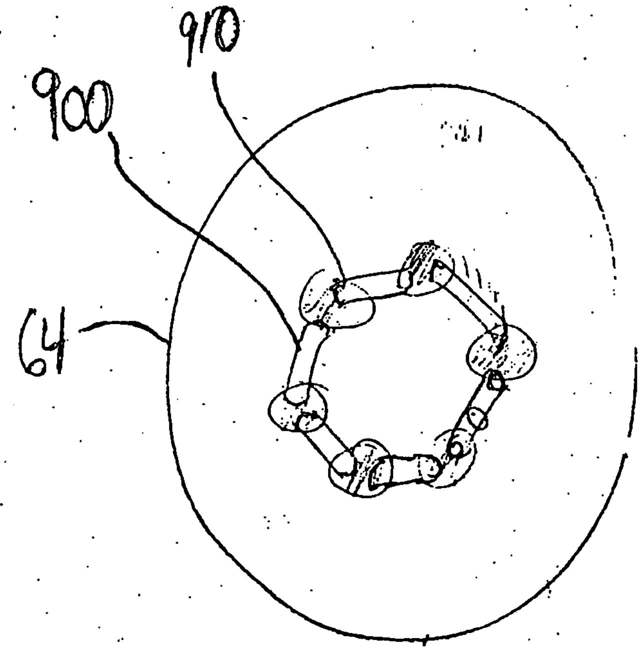
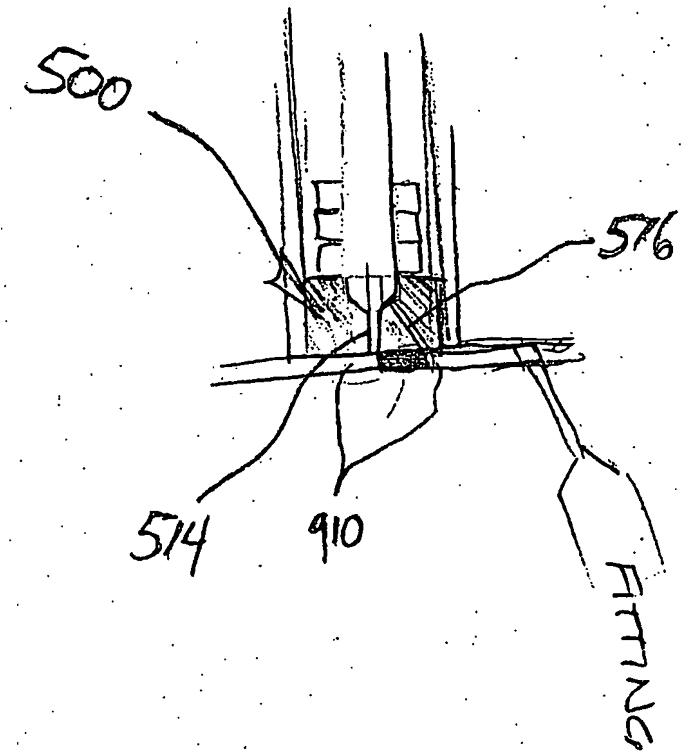


FIG. 10



PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

JANIUK, Anthony, J., Janiuk
Waters Investments Limited
Waters Corporation
34 Maple Street - LG
Milford, MA 01757
ETATS-UNIS D'AMERIQUE

Date of mailing *(day/month/year)* 29 April 2005 (29.04.2005)	
Applicant's or agent's file reference AF-355-6-7	**IMPORTANT NOTIFICATION**
International application No. PCT/US05/005714	International filing date *(day/month/year)* 18 February 2005 (18.02.2005)
International publication date *(day/month/year)*	Priority date *(day/month/year)* 19 February 2004 (19.02.2004)
Applicant WATERS INVESTMENTS LIMITED et al	

1. By means of this Form, which replaces any previously issued notification concerning submission or transmittal of priority documents, the applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to a date of receipt, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. *(If applicable)* The **letters "NR"** appearing in the right-hand column denote **a priority document which, on the date of mailing of this Form, had not yet been received by the International Bureau** under Rule 17.1(a) or (b). Where, under Rule 17.1(a), the priority document must be submitted by the applicant to the receiving Office or the International Bureau, but the applicant fails to submit the priority document within the applicable time limit under that Rule, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

3. *(If applicable)* **An asterisk (*)** appearing next to a date of receipt, in the right-hand column, denotes **a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b)** (the priority document was received after the time limit prescribed in Rule 17.1(a) or the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b)). Even though the priority document was not furnished in compliance with Rule 17.1(a) or (b), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
19 February 2004 (19.02.2004)	60/545,829	US	23 March 2005 (23.03.2005)

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